

## Research Paper

# The Relationship Between Food Insecurity, C-Reactive Protein and Some Socio-Economic Variables in Type 2 Diabetes



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### Keywords:

Type 2 diabetes, Food insecurity, Inflammation

## ABSTRACT

**Background** Food insecurity can contribute to health and nutrition problems. Thus, determining its associated factors seems necessary in all societies.

**Objective** The current study determined the food insecurity, C-Reactive Protein (CRP) and some socio-economic factors in type 2 diabetic patients in Minoodar and Shohada comprehensive health centers of Qazvin in 2016.

**Methods** This case-control study was performed on 200 type 2 diabetic patients with an average age of  $47.1 \pm 8.2$  and 200 healthy individuals with an average age of  $46.3 \pm 8.6$ . Food security was determined using the Household Food Security Questionnaire. Data from anthropometric, was collected, Biochemical factors were assessed using a blood test and Physical activity was measured using International Physical Activity questionnaire (IPAQ). Chi-square test to determine the relationship between independent qualitative variables and independent T-test to determine the relationship between quantitative variables for the comparison of mean for two independent groups of the Man-Vinet test and Kruskal-Wallis test for meaningful differences in general characteristics. Moreover, multivariate logistic regression was used to moderate the effects of misleading variables and software N4 for data analysis. The minimum significant difference was considered to be less than 0.05.

**Findings** The Mean  $\pm$  SD age of the patients and healthy subjects were  $47.1 \pm 8.2$  and  $46.8 \pm 3.6$ , respectively. There was a significant correlation between food insecurity and socio-economic variables affecting type 2 diabetes. Food insecurity in the case group was significantly associated with fasting blood glucose ( $P=0.02$ ) and inflammation factor (CRP) and WBC ( $P<0.001$ ).

**Conclusion** Increased food insecurity was associated with enhanced inflammation and type 2 diabetes; therefore, health planners should pay attention to reducing food insecurity in the community, especially in people with type 2 diabetes. This could be achieved by improving the economic situation and modifying household food patterns.

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## Extended Abstract

### 1. Introduction

**D**iabetes mellitus is a group of metabolic disorders associated with increased blood glucose level. This increase is due to the impaired secretion of insulin, insulin function, or both [1]. Food security indicates that all people at all times have access to adequate nutritionally designed foods to ensure healthy and active living, as well as to ensure people can access convenient food through approved methods [3-5]. The high prevalence of food insecurity and type 2 diabetes have been reported in Iran. Moreover, no study has been conducted in Iran on the relationship between the inflammatory factor and food insecurity. Thus, the present study examined the association of food insecurity, inflammation and some socioeconomic factors with type 2 diabetes.

### 2. Methods and Materials

In this study, 400 middle-aged individuals participated from Qazvin Province, Iran. Of whom, 200 were enrolled into the case group, including those with type 2 diabetes diagnosed with diabetes by a diabetic specialist. They had an electronic medical record since 2016. They also received a long-term treatment under the supervision of a diabetic specialist. In addition, 200 individuals were enrolled into the control group. This group included healthy individuals who were randomly selected via random sampling method from the comprehensive health centers of Shohada and Minoodar in Qazvin in 2017 and were homogenized in terms of age and gender. Considering the significance level of 5% and power of at least 90%, the sample size was estimated to be 200 for each group based on Najibi and Khosravi study [25, 26].

The inclusion criteria were the age range of 30-60 years, the lack of metabolic, infectious and inflammatory diseases, no estrogen hormones consumption (both study groups), type 2 diabetes (with a fasting blood glucose standard of  $>126$  mg/dL) and no changes in the treatment method and medications regimen over at least two months (case group). Exclusion criteria included pregnancy and lactation, refusing to participate in the research, and people with a specific diet or diet changes over the past 2 months due to the history of heart diseases or heart strokes, cancer, and acute renal diseases.

The patients were tested at Shohada Health Center Lab. The latest biochemical tests data including fasting blood glucose and lipid profile were reviewed from the patient's records and recorded in a questionnaire. Household food security was assessed using the Household Food Security questionnaire entailing 18 items [19]. The validity and reliability of men-

tioned questionnaire have been surveyed in Rafiei et al. study [20]. All the questionnaires were completed using interview method by a trained person. By the Bikel method, the subjects were divided into 4 groups based on their obtained scores of this questionnaire [21] involving food secure, food insecure without hunger, food insecure with moderate hunger and food insecure with severe hunger.

The physical activity level was measured by the International Physical Activity Questionnaire (IPAQ) through conducting interviews with the subjects. This questionnaire contains questions that examine a person's physical activity level, which classifies the level of individuals' physical activity into three weak, moderate and severe levels. This questionnaire has been used in various studies in Iran, which its validity and reliability have been previously reported [22].

Chi-squared test was applied to determine the relationship between the independent qualitative variables and the Independent Samples t-test was used to determine the relationship between the quantitative variables. For the comparison of mean scores of the two independent groups, the Mann-Whitney U test was used. The Kruskal-Wallis test was applied to explore the significant differences in general characteristics based on variance quartiles. Additionally, multivariate logistic regression was used to moderate the effects of misleading variables and software N4 was applied for data analysis. The minimum significant difference was considered to be  $<0.05$ .

### 3. Results

No significant difference was observed between the two groups in terms of age, gender, marital status, household dimension, and the occupational status. The two groups were significantly different with respect to the occupation ( $P=0.005$ ), economic status ( $P<0.001$ ), education ( $P=0.01$ ), number of items of life ( $P<0.001$ ), and Body Mass Index (BMI) ( $P<0.001$ ). The prevalence of food insecurity was 24.9% and 71%, in the control and case groups, respectively. Of which, 65.5% were food insecure without hunger, 3.5% were food insecure with moderate hunger and 2% were food insecure with severe hunger.

The prevalence of food insecurity in the case and control groups was significantly different ( $P<0.001$ ). The level of blood glucose in food insecure individuals was 1.16 times higher than that of food secure individuals, which this difference was significant ( $P=0.02$ ). There was no statistically significant difference between the insecure food and secure food groups with regards to the serum level of lipid profiles and blood pressure ( $P<0.05$ ). The rate of inflammatory factors in food insecure individuals were significantly higher than those

of food secure individuals ( $P < 0.001$ ) based on the results of final model of logistic regression.

The final independent variables affecting type 2 diabetes were food insecurity, BMI, occupational status of the individual responsible for household food supply, number of items of life, economic status, and education. Logistic regression model demonstrated that by moderating the effect of confounding variables (assuming the effect of other variables to be constant), the insecure food people were 4.74 times more overweight than secure food subjects, and obese people faced the risk of type 2 diabetes 1.13 times more than normal individuals.

The risk for type 2 diabetes is 3.5% higher in unemployed individuals responsible for household food supply (often themselves or their spouses), compared to those who are employed. Moreover, the risk for type 2 diabetes in households with fewer than 3 items of life is 1.78 times more than those who have more than 3 items of life. Additionally, households with a weak and average economic status experience the risk for type 2 diabetes for 1.66 times more than those households with good economic status. Furthermore, the risk for type 2 diabetes in households with a diploma and sub-diploma is 1.02 times more than higher-educated households.

#### 4. Conclusion

The present study, conducted on the middle-aged people in Qazvin City, showed a significant direct relationship between food insecurity and type 2 diabetes. About 71% of people with type 2 diabetes and 24.9% of the controls showed mild to severe insecurity, so there was a statistically significant relationship between type 2 diabetes and food insecurity. Based on the association between food insecurity and type 2 diabetes, the prevalence of diabetes in food secure groups, mild food insecure, and severe food insecure groups were respectively 11.7%, 10%, and 16.1%. After adjusting for the factors related to social demography and physical activity, it was found that the prevalence of diabetes is higher within individuals with severe food insecurity compared to those with mild food insecurity and those without food insecurity [24].

Kendall et al. reported that underlying causes such as the low economic status and food insecurity make people spend less on food, reduce their food intake, and change the type of food they consume. Therefore, food diversity decreases and the consumption of high-calorie foods increases [27]. These high-calorie foods include refined grains, trans or saturated fat, which are nutritionally low in quality and cheaper than their counterparts with the same calorie [39].

These nutritional patterns will result in obesity, high blood pressure, increased blood lipids, and diabetes. There was a

significant relationship between type 2 diabetes and poor economic status. In some studies, food insecurity has been proven to have a significant relationship with the economic level [40]. In general, the findings of the present study can be justified. That is unfavorable socioeconomic status can lead to limited access to nutrients and energy. This condition can scare people of food shortage, lack of choice, and inevitable change in food habits, all due to economic constraints, which is another aspect of food insecurity.

The level of fasting blood glucose demonstrated a significant positive relationship with food insecurity. Drewnowski et al. stated that food-insecure people eat cheap foods that are inadequately nutritious though they have a high energy density [41]. There was a significant positive correlation between CRP level, WBC count, and food insecurity. Gowda et al. demonstrated that diet patterns and dietary preferences would change within insecure people due to nutritional deficiencies and inadequate energy intake, [42].

The results of this study may indicate that food insecure individuals are more susceptible to inflammation, which may lead to noncommunicable diseases such as diabetes, hypertension, and cardiovascular disease. The present study is the first case-control study in Iran that investigated food insecurity and inflammatory factors. These factors can be mentioned as the strong points of this study and can serve as a basis for further research. Another strong point is adjusting the effect of potential confounding factors in multivariate regression logistic models.

#### Ethical Considerations

##### Compliance with ethical guidelines

There was no ethical considerations to be considered in this research.

##### Funding

The present paper was extracted from the MSc. thesis of the first, in Department of Health Sciences in Nutrition, School of Public Health, International Campus, Shahid Sadoughi University of Medical Sciences and Health Services.

##### Authors' contributions

Conceptualization: Hamideh Janzadeh; and Research, edition and finalization: All authors.

##### Conflict of interest

The authors declared no conflict of interest.

## بررسی ارتباط ناامنی غذایی، پروتئین و اکشنگر C و برخی متغیرهای اجتماعی اقتصادی با ابتلا به دیابت نوع ۲

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### چکیده

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**زمینه:** با توجه به اینکه ناامنی غذایی می تواند پیش زمینه مشکلات سلامتی و تغذیه ای باشد، تعیین عوامل مرتبط با آن در هر جامعه ای ضروری به نظر می رسد.

**هدف:** هدف از این مطالعه، بررسی میزان امنیت غذایی، پروتئین و اکشنگر C و برخی متغیرهای اجتماعی اقتصادی در بیماران دیابتی نوع ۲ بود. **مواد و روش ها:** این مطالعه موردشاهدی در سال ۱۳۹۶ در مراکز جامع سلامت شهدا و مینودر قزوین روی ۲۰۰ فرد مبتلا به دیابت نوع ۲ و ۲۰۰ فرد سالم انجام شد. امنیت غذایی با استفاده از پرسش نامه امنیت غذای خانوار سازمان کشاورزی ایالات متحده آمریکا محاسبه و داده های آنتروپومتریک جمع آوری شد. عوامل بیوشیمیایی با آزمایش خون و فعالیت بدنی با استفاده از پرسش نامه بین المللی فعالیت فیزیکی اندازه گیری شد. برای تعیین ارتباط بین متغیرهای مستقل کیفی از آزمون کای دو، برای تعیین ارتباط بین متغیرهای کمی از آزمون تی مستقل، برای مقایسه میانگین دو گروه مستقل از آزمون من وینتی و از آزمون کروسکال والیس برای تفاوت های معنی دار در ویژگی های کلی بر اساس چارک های تنوع غذایی و از رگرسیون لجستیک چندمتغیره به منظور تعدیل اثر متغیرهای مخدوشگر و از نرم افزار SPSS ۲۴ برای آنالیز داده های غذایی استفاده شد.

**یافته ها:** میانگین سنی افراد مبتلا ۴۷/۱±۸/۲ و سالم ۴۶/۸±۲/۶ سال بود. ناامنی غذایی و برخی متغیرهای اجتماعی اقتصادی با دیابت نوع ۲ ارتباط معنی داری داشتند. ناامنی غذا در گروه آزمایش با قند خون ناشتا ( $P=0/02$ ) و عامل التهاب (پروتئین و اکشنگر C و تعداد گلبول سفید) ارتباط معنی داری را نشان داد ( $P<0/001$ ).

**نتیجه گیری:** از آنجا که افزایش ناامنی غذایی با افزایش التهاب و دیابت نوع ۲ مرتبط بود، برنامه ریزان باید به کاهش ناامنی غذایی در جامعه به ویژه افراد مبتلا به دیابت نوع ۲ از طریق بهبود وضعیت اقتصادی و اصلاح الگوهای غذایی خانوار توجه داشته باشند.

### کلیدواژه ها:

دیابت نوع ۲، ناامنی غذایی، التهاب

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